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WESTERN ATLANTIC *DONAX*

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Continuing misconceptions of speciation of *Donax* and mis-identifications of species living on the coasts of Virginia and the Carolinas prompted this review of all Western Atlantic *Donax* species. Critical microscopic study of the collections of *Donax* in the Smithsonian Institution and of those in the Academy of Natural Sciences of Philadelphia (more than 500 samples and more than 45,000 specimens) and of the literature, has produced clear and specific answers. There are eleven forms of *Donax* living along Western Atlantic shores. Each of the ten distinct species and one subspecies has a distinct geographic range. The geographic ranges of certain species overlap. In a number of cases two (sometimes three) species may be living on the same shores. In three cases there is a definite ecological zonation indicated for such dual occupation of the sandy beach habitats. Because they are not completely separated throughout the year, more than one species of *Donax* of the Western Atlantic has often been collected in, and left mixed in museums, in the same sample.

These studies indicate that a two year life-span is normal for all six *Donax* that are recorded from the Atlantic shores of the United States and Mexico, just as reported for the Californian species *Donax gouldi* by Coe 1955, and for the Indian *Donax* (*Latona*) *cuneata* by Nayar 1955.

All reports of United States *Donax* being "annual" species are based on mixtures of species incompletely collected and/or analyzed.

In this monograph the species are arranged in a geographic and group series. All species known to be living on Western

Atlantic shores are figured here together; three for the first time. Pertinent references are listed chronologically under each species heading.

Donax fossor Say 1822

Pl. 1, Fig. F; and Pl. 2, Fig. F

1822. *Donax fossor* Say, Journ. ANSP., 2: 306.
 1834. *Donax fossor* Say, Amer. Conch., plate 61, fig. 2.
 1843. *Donax fossor* DeKay, Nat. Hist. N. Y., p. 211, pl. 23, fig. 255.
 1843. *Donax fossor* Hanley, Bivalve Shells, p. 85.
 1844. *Donax fossor* Hanley, Bivalve Shells, p. 349, pl. 9, fig. 36.
 1857. *Donax variabilis* Tuomey & Holmes (not of Say), Pl. Fossils S. Car., p. 95, pl. 23, fig. 6.
 1858. *Donax fossor* Say, Binney's Edn. Amer. Conch., plate 61, fig. 2.
 1869. *Donax fossor* Tryon, Am. Journ. Conch., 4 (5): append., p. 112.
 1869. *Donax (Serrula) fossor* Romer, Conch. Cab., 10 (3): p. 52, pl. 9, figs. 11-14.
 1881. *Donax fossor* Bertin, Nouv. Archiv. Mus. (ser. 2), 4: 93.
 1889. *Donax fossor* Dall, Bull. 37 USNM, p. 58.
 1890. *Donax fossor* Dall (in part), Tert. Fauna Fla., 3 (5): 967.
 1892. *Donax fossor* Dall, Nautilus, 5 (11): 126.
 1903. *Donax fossor* Dall, Bull. 37 USNM, Reprint, p. 58.
 1920. *Donax fossor* Maury, Bull. Amer. Paleont., 8: 128.
 1922. *Donax fossor* Jacot, Nautilus, 36 (2): 60.
 1922. *Donax variabilis* Jacot (in part), Nautilus, 36 (2): 60.
 1927. *Donax variabilis* Wood & Wood (not Say), Nautilus, 41: 10.
 1927. *Donax fossor* Johnson, Nautilus, 41: 140.
 1929. *Donax variabilis* Jacot (in part), Nautilus, 42 (4): 142-143.
 1929. *Donax fossor* Johnson, Nautilus, 43 (1): 28-30.
 1934. *Donax fossor* Johnson, Proc. Boston Soc. Nat. Hist., 40 (1): 53.
 1937. *Donax fossor* M. Smith, East Coast Marine Shells, p. 62, pl. 10, fig. 12.
 1940. *Donax fossor* Alexander, Nautilus, 54: 127.
 1951. *Donax fossor* Morris, Field Guide Shells, 2nd Edn., p. 82.
 1954. *Donax fossor* Abbott, American Sea Shells, p. 437.
 1955. *Donax fossor* Jacobson, Nautilus, 68 (3): 73-77.
 1961. *Donax fossor* Jacobson & Emerson, Shells, N. Y. City, p. 93, fig'd.
 1967. *Donax fossor* Jacobson, N. Y. Shell Club Notes, No. 134: 2.
 1968. *Donax fossor* Abbott, Sea Shells N. America, p. 248, fig'd.
 1969. *Donax variabilis* Chanley (not Say), Bull. Marine Sci., 19 (1): 214-224.
 1969. *Donax fossor* Chanley (in part), Nautilus, 83 (1): 1-14.

Type locality: *fossor* Coasts of New Jersey and Maryland (Say, 1822).

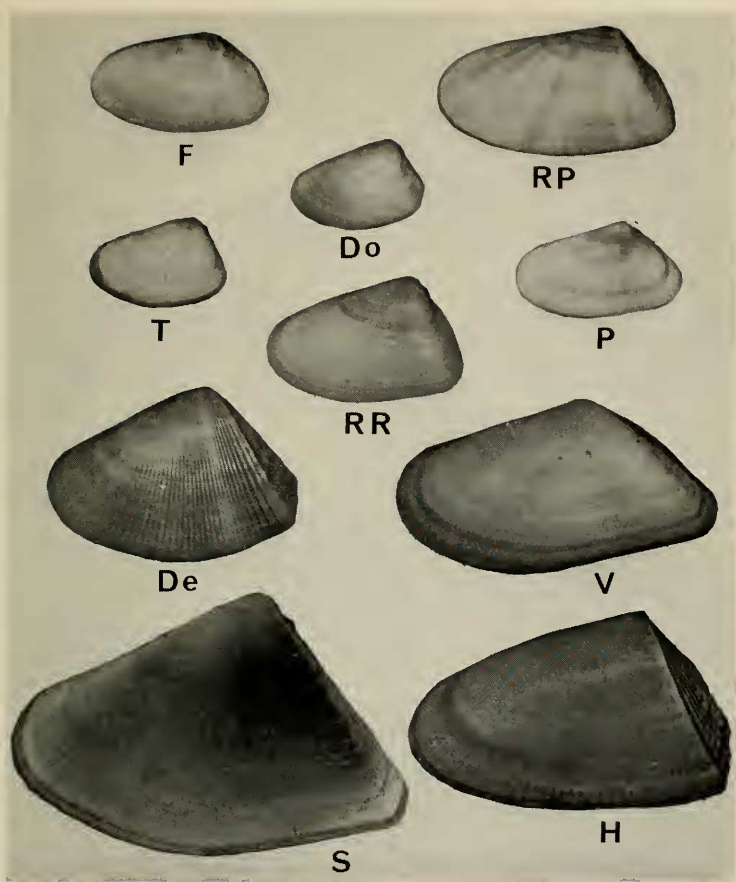


Plate 1

F = *fossor* Say. USNM no. 679770, Ocean City, Maryland. RP = *roemeri protracta* Conrad. USNM no. 679771, 77° West Longitude, North Carolina. P = *parvula* Philippi. USNM no. 679772, Windy Hill Beach, South Carolina. Do = *dorotheae*, New Species, Holotype USNM no. 679773, Alligator Point, Franklin Co., Florida, 14.0 mm. T = *texasiana* Philippi. USNM no. 679127, Galveston, Texas. RR = *roemeri roemeri* Philippi, USNM no. 598104. Port Aransas, Texas. De = *denticulata* Linnaeus, USNM no. 660273, Mayaguez, Puerto Rico. S = *striata* Linnaeus, USNM no. 253131, Wounta Haulover, Nicaragua. V = *vellicata* Reeve, USNM no. 518549, Chaguaramas Bay, Trinidad. H = *hilairea* Guérin, USNM no. 341711, La Paloma, Uruguay. (All figures approximately $1\frac{1}{4}\times$.)

D. fossor lives on the coasts from Nag's Head, North Carolina to New Jersey. Intermittently, populations of this species are established on the south shore of Long Island, New York. It is distinct and overlaps part of the range of *Donax roemeri protracta* without any hybridization or intergradation. No living *Donax fossor* have been seen south of Cape Hatteras, North Carolina.

Shell distinctions between the species *fossor* and *roemeri protracta*, with which it may be living in the sand beaches between the mouth of Chesapeake Bay and Cape Hatteras, are positive even if not immediately evident. The shell of *Donax fossor* is more evenly radially sculptured throughout its length. *D. roemeri protracta* is much more distinctly and strongly radially ridged on the posterior slope. Particularly in the juveniles of about 5 mm length, the escutcheon area of *Donax roemeri protracta* is more rounded toward the vertical, not regularly sloping parallel to the rounded posterior ridge as in *fossor*. With the thickened lips apparent on the anterior curve of the shell in *roemeri protracta*, that same anterior end of the shell is proportionately vertically narrower in *roemeri protracta* than it is in *fossor* shells of the same size. Note that the thickened anterior lips of *roemeri protracta* were figured by Say in 1834, in distinguishing *fossor* from his second species (*variabilis*).

In 1969, a marked difference in ecology and life history between *D. fossor* and *D. roemeri protracta* was discovered. When *D. fossor* disappears from the beaches at the end of the season, it moves outside the intertidal zone, to spend the rest of the winter and spring in surf and subtidal waters. Chanley's theory regarding *fossor* as a "summer range extension of *variabilis*" (*Nautilus* 83:1-14:1969) was proven incorrect by the collection of specimens of the species *fossor* by me in May 1969 and in February and April 1970. All the *Donax* from the Wachapreague region of Virginia studied by Chanley, belong to the species *fossor* Say. He experimentally raised young from *fossor* parents, that "set" as *fossor*. They cannot be identified as any other species.

One hundred and one living juveniles of *fossor* were dredged in 2 and 3 feet of water 10 to 30 feet offshore, off the north end of Parramore Island, Accomack Co., Virginia on 23 Feb. 1970, with the help of Michael Castagna of the Virginia Institute of Marine Science at Wachapreague. These specimens of *fossor* (USNM No. 701590 and No. 701601) were between 2.1 and 7.6 mm long, with an average length of 3.94 mm.

On 19 April 1970, a population of *Donax fossor* previously sampled at Sand Bridge Beach, Princess Anne Co., Virginia on 30 September 1969, was relocated and, under storm conditions, four living juveniles of *Donax fossor* were dredged from the shoreward fringe of the population, in 3 feet of water at or near low tide. These four specimens (USNM No. 701583) measured from 3.2 to 5.2 mm in length, with an average length of 4.3 mm. The previous season, living juveniles were dredged in 4 and 6 feet of water off Cedar and Parramore Islands, Accomack Co., Virginia, 17 May 1969, also with the help of Castagna and his staff. These

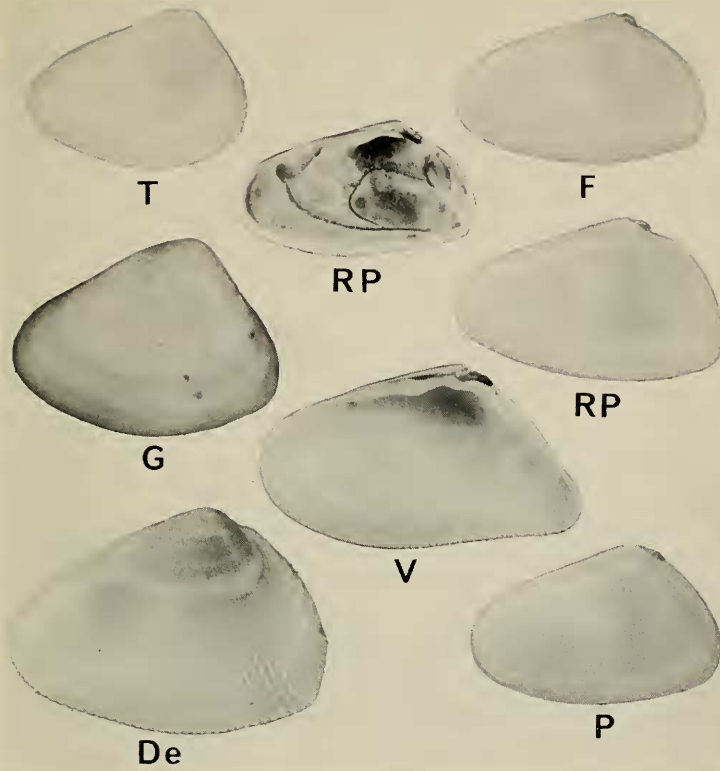


Plate 2

T = *texasiana* Philippi, Juvenile, USNM no. 33721, Corpus Christi, Texas. F = *fossor* Say, Juvenile, USNM no. 680622, Ocean City, Maryland. RP = *roemeri protracta* Conrad, Right valve interior showing pallial sinus, USNM no. 680624, 77° West Longitude, North Carolina. RP = *roemeri protracta* Conrad, Juvenile, USNM no. 680623, 77° West Longitude, North Carolina. G = *gemmula*, New Species, Holotype (enlarged), ANSP No. 244125, Rio Grande do Sul, Brazil, 6.5 mm. V = *vellicata* Reeve, Right valve interior showing pallial sinus. USNM no. 518549, Chaguaramas Bay, Trinidad. De = *denticulata* Linnaeus, Juvenile, USNM no. 534936, Greytown, Nicaragua. P = *parvula* Philippi, Juvenile, USNM no. 680625, Windy Hill Beach, South Carolina. (Figures of juveniles approximately $3\frac{1}{8}\times$. Pallial sinus figures approximately $1\frac{1}{4}\times$.)

juveniles of 17 May 1969 (USNM numbers 701638, 701639 and 701641) ranged between 3.0 and 7.2 mm long with an average length of 4.26 mm.

Unlike the 4 to 5 mm long juveniles of the intertidal beach sand collected by me at Ocean City, Md., Sept. 1963, which were uniformly smooth, these Feb. 23rd and April 19th and May 17th juveniles had overwintered. They show a marked winter ring on every shell. Measurement of ten population samples (more than 6000 specimens) has conclusively shown that a two year life span is normal for this most northern Western Atlantic species, *Donax fossor* Say. A few of the largest specimens seen may have survived into their third season, as did the Weingartner Collection of May 30 from Beach Haven Inlet, New Jersey reported by Chanley (1969, p. 7).

Donax roemeri protracta Conrad 1849

Pl. 1, fig. RP; and Pl. 2, figs. RP

1822. *Donax variabilis* Say, Journ. ANSP, 2: 305. (not: (*Donax*) *Latona variabilis* Schumacher 1817).
1834. *Donax variabilis* Say, Amer. Conch., plate 61, fig. 1.
1843. *Donax variabilis* Hanley, Bivalve Shells, p. 85.
1844. *Donax variabilis* Hanley, Bivalve Shells, p. 349, pl. 14, fig. 3.
1849. *Donax protracta* Conrad, Journ. ANSP (2nd ser.), 1: 208, 280, pl. 39, fig. 8.
1854. *Donax variabilis* Reeve, Conch. Icon., 8 (*Donax*) plate 7, sp. 47.
1858. *Donax variabilis* Say, Binney's Edn. Amer. Conch., plate 61, fig. 1.
1860. *Donax variabilis* Stimpson, Am. Journ. Sci., May 1860, p. 443.
1866. *Donax variabilis* Sowerby, Thesaurus, 3: 309, sp. 27, figs. 37-39.
1866. *Donax angustatus* Sowerby, Thesaurus, 3: 309, sp. 29, fig. 44.
1869. *Donax angustatus* Tryon, Am. J. Conch., 4 (5): append., p. 112.
1869. *Donax protractus* Tryon, Am. J. Conch., 4 (5): append., p. 113.
1869. *Donax variabilis* Tryon, Am. J. Conch., 4 (5): append., p. 114.
1869. *Donax variabilis* Romer, Conch. Cab., 10 (3): p. 45, pl. 8, figs. 9-14.
1871. *Donax variabilis* Coues, Proc. ANSP, p. 137.
1878. *Donax variabilis* Calkins, Proc. Davenport Acad. Sci., p. 248.
1878. *Donax protractus* Calkins, Proc. Davenport Acad. Sci., p. 248.
1881. *Donax variabilis* Bertin, Nouv. Arch. Mus. (ser. 2), 4: 91.
1881. *Donax angustatus* Bertin, Nouv. Arch. Mus. (ser. 2), 4: 98.
1881. *Donax protractus* Bertin, Nouv. Arch. Mus. (ser. 2), 4: 104.
1889. *Donax variabilis* Dall, Bull. 37 USNM, p. 58.
1889. *Donax variabilis* Simpson, Proc. Davenport Acad. Sci., 5: 63.
1890. *Donax variabilis* Johnson, Nautilus, 4 (1): 5
1892. *Donax variabilis* Dall, Nautilus, 5 (11): 125.
1900. *Donax variabilis* Dall, Tert. Fauna Fla., 3 (5): 969.
1903. *Donax variabilis* Dall, Bull. 37 USNM, reprint p. 58.
1903. *Donax variabilis* Vanatta, Proc. ANSP, 55: 757.

1913. *Donax variabilis* Mazyck, Contrib. Charleston Mus. II, Cat. Moll. S. Carolina, p. 30.
1919. *Donax variabilis* Johnson, Nautilus, 33 (1): 4.
1920. *Donax fossor* Maury (in part), Bull. Amer. Paleont., 8: 128.
1920. *Donax variabilis* Maury, Bull. Amer. Paleont., 8: 129.
1922. *Donax variabilis* Jacot (in part), Nautilus, 36 (2): 60.
1927. *Donax variabilis* Johnson, Nautilus, 41 (1): 140.
1929. *Donax variabilis* Jacot (in part), Nautilus, 42 (4): 142-143.
1929. *Donax variabilis* Johnson, Nautilus, 43 (1): 29.
1934. *Donax fossor protractus* Johnson, Proc. Boston Soc. Nat. Hist., 40 (1): 53.
1934. *Donax variabilis* Johnson, Proc. Boston Soc. Nat. Hist., 40 (1): 54.
1936. *Donax variabilis* Pearse, Journ. Elisha Mitchell Sci. Soc., 52 (2): 189.
1937. *Donax variabilis* M. Smith, E. Coast Marine Shells, p. 62, pl. 25, fig. 10.
1940. *Donax variabilis* Haas, Amer. Midland Nat., 24 (2): 370-371.
1942. *Donax variabilis* Pearse, et al. (in part), Ecol. Mon., 12: 135-190.
1945. *Donax variabilis* Vilas & Vilas, Florida Marine Shells, p. 45, pl. 5, figs. 4 a-d.
1947. *Donax variabilis* Morris, Field Guide Shells, p. 57, pl. 14, fig. 1.
1951. *Donax variabilis* Morris, Field Guide Shells, Edn. 2, p. 81, pl. 12, fig. 1.
1954. *Donax variabilis* Abbott, Amer. Sea Shells, p. 437, pl. 30r.
1955. *Donax variabilis* Perry & Schwengel, Marine Shells, S. W. Fla., Edn. 2, p. 86, pl. 17, fig. 109.
1957. *Donax variabilis* Turner & Belding (in part), Linn. Oceanogr., 11 (2): 120-124.
1957. *Donax variabilis* Siekman, Handbook of Fla. Shells, Great Outdoors Assn., St. Pete., Fla., p. 40.
1959. *Donax variabilis* Aldrich, Atlantic Naturalist, Jan.-Mar., pp. 41-43.
1959. *Donax variabilis* Edgren, Ecology, 40 (3): 498-502.
1961. *Donax variabilis* Moore, Gulf Research Reports, 1 (1): 46.
1968. *Donax variabilis* Abbott, Sea Shells N. America, p. 248, fig'd.
1969. *Donax variabilis* Chanley (in part), Nautilus, 83 (1): 1-14.

Type localities: *variabilis* Coasts of Georgia and E. Fla. (Say, 1822); *protracta* Coast of Florida, near St. Joseph's Bay, (Conrad 1849); *angustatus* United States (Sowerby 1866).

The familiar name *variabilis* Say 1822 is preoccupied by *Latona variabilis* Schumacher 1817, proposed as a new name for *Donax cuneatus* Linnaeus when it was transferred to the new genus *Latona*. Note that this specific renaming was a requirement in the time of Schumacher and Lamarck, upon transfer to another genus. As long as *Latona* and other groups are considered subgenera, but still in *Donax*, the name *Donax variabilis* Say 1822 cannot be used. In its place we are using the next available name, *Donax roemeri protracta* Conrad 1849. Conrad's name for

the eastern subspecies was published about five months after *Donax roemeri* Philippi appeared in March 1849.

This eastern subspecies of *roemeri* is recorded from Virginia Beach, Virginia southward and westward to Alabama and Mississippi. It is present in all years from Cape Hatteras, North Carolina southward, but only intermittently does it overlap, and live in the same sands with, *Donax fossor* north of Cape Hatteras.

In contrast to the shells of *fossor* living to the north; of *parvula* living alongside it from Ocracoke, North Carolina to St. Lucie Co. Park, Florida; and of *dorotheae* living alongside it on the northern shores of the Gulf of Mexico, the shells of *roemeri protracta* are strongly radially striate on the posterior slope. The posterior ridge of *protracta* is much more abrupt than that of the smaller species that may be living with it.

As far as known, *Donax roemeri protracta* lives in the intertidal beach sands throughout the entire year. In fact, this species may have part or all of the population inactive or "stranded" in the mid-tidal sand whenever the tide is low. In South Carolina, *protracta* was found completely "stranded" in December 1959, partially "stranded" in June 1960, and probably 98 percent "stranded" in a 10 ft. wide band of pock-marked sand in the upper intertidal zone near the high tide line on 14 July 1969.

The lumping of almost all *Donax* from the Carolina region under the name *variabilis* in previous studies, has confused more than the species picture. In scores of samples studied in the Smithsonian Institution and the Academy of Natural Sciences of Philadelphia collections, the "young" included the following species (*D. parvula* Philippi). Because of their collection, study, and deposit in collections as mixtures, these samples indicate the need to repeat all research on the ecology, spawning, growth, and life spans of *Donax* species on the Carolina coasts, before the results of such researches can be accepted at full value.

When *protracta* has been correctly identified, and the admixed *parvula* has been separated, the two year life-span of both species can be readily seen. Collections made near Beaufort, North Carolina in April 1912, and in June 1960, both show a normal two year life-span, with a three year span for some individuals of *D. roemeri protracta*. In both of these cases, *D. parvula* living in the same sand of the same beaches confused the growth picture until the two species had been separated. The statements of Pearse (1942, p. 156) that *protracta* is an "annual", and of Chanley (1969, p. 3) that the average size of *Donax* does not increase during the season in North Carolina, are understandable mistakes based on mixed samples of *protracta* and *parvula*.

Donax parvula Philippi 1849

Pl. 1, fig. P; and Pl. 2, fig. P

1849. *Donax parvula* Philippi, Zeits. f. Malakoz., 5 (10): 146.

1869. *Donax parvulus* Tryon, Am. J. Conch., 4 (5): append., p. 113.

1881. *Donax parvulus* Bertin, Nouv. Arch. Mus. (ser. 2), 4: 103.

1889. *Donax obesa* Dall (in part), Bull. 37 USNM, p. 58 (St. Augustine).
1889. *Donax fossor* Simpson, Proc. Davenport Acad. Sci., 5: 63 (Mayport, Fla., Upson).
1890. *Donax obesa* Johnson (not Orbigny 1846), Nautilus, 4 (1): 5.
1892. *Donax tumida* Dall (in part), Nautilus 5 (11): 126.
1892. *Donax parvula* Dall, Nautilus, 5 (11): 126.
1900. *Donax fossor* Dall (in part), Tert. Fauna Fla., 3 (5): 967.
1903. *Donax obesa* Dall (in part), Bull. 37 USNM Reprint, p. 58 (St. Augustine).
1913. *Donax fossor* Mazyck, Contrib. Charleston Mus. II., Cat. Moll. S. Carolina, p. 30.
1919. *Donax obesa* Johnson (not Orbigny 1846), Nautilus, 33 (1): 4.
1920. *Donax fossor* Maury (in part), Bull. Amer. Paleont., 8: 128.
1920. *Donax tumida* Maury (in part), Bull. Amer. Paleont., 8: 128.
1929. *Donax tumida* Johnson (in part), Nautilus, 43 (1): 30.
1934. *Donax tumidus* Johnson (in part), Proc. Boston Soc. Nat. Hist., 40 (1): 54.
1936. *Donax fossor fossor* Pearse, Journ. Elisha Mitchell Sci. Soc., 52 (2): 189.
1937. *Donax tumida* M. Smith (in part), East Coast Marine Shells, p. 62, pl. 10, fig. 9.
1942. *Donax variabilis* Pearse, et al. (in part), Ecol. Mon., 12: 156.
1957. *Donax variabilis* Turner & Belding (in part), Limm. Oceanogr., 11 (2): 120-124.
1969. *Donax variabilis* Dexter, Chesapeake Sci., 10 (2): 93-98.
1969. *Donax variabilis* Chanley (in part), Nautilus, 83 (1): 1-14.

Type locality: Florida? (Philippi 1849); here confirmed, and restricted to Jacksonville Beach, Florida.

Donax parvula Philippi 1849 has been incorrectly listed as *obesa* and as *tumida* from East Florida; and as *fossor* from south of Cape Hatteras, North Carolina. Never previously figured, it does not attain the maximum size of *roemeri protracta* with which it has usually been collected. It may be easily distinguished from *protracta* by the lack of distinct radial sculpture over most of the shell. Over the subangulate posterior ridge, and on the posterior slope of *protracta*, the radial ribs are most prominent, and more or less sharply incised. In contrast, *D. parvula* has a smaller, thicker shell, more glossy in appearance, with a rounded posterior ridge ending in an evenly rounded postbasal curve. The posterior slope of *parvula* is glossy, and is not externally radially ribbed. It is presently known to be living from Ocracoke, North Carolina southward to St. Lucie Co. Park, Florida. The most recently published ecological study on *Donax* in the Beaufort area probably concerns only *D. parvula*, living inside the mouth of the Beaufort estuary system. (Dexter 1969).

The St. Augustine, Florida record (1890 & 1919) of C. W. Johnson of "*obesa*" stated that it was common at the mouth of the lagoon. Nearly

all other samples of *parvula* in the Smithsonian Institution and the Philadelphia Academy collections were collected with, and were left mixed with, lots of *protracta* (both active and inactive) from the mid-tidal sands of narrow beaches. On the extremely wide beach at Ocean Drive Beach, South Carolina, on 14 July 1969, *Donax parvula* was found living alone in a zone near the low tide line (in three feet of water at time of mid-tide), about 30 yards seaward of the high tide line zone of the "stranded" *Donax roemeri protracta* population. At this time and place there was no overlap of the two *Donax* populations, although many empty, paired shells of both species were evident in the drift at the high tide line. If it proves constant, this low to sub-tidal zonation of *parvula* appears to parallel that reported for *texasiana* by Loesch in 1957, and now known for the previously unnamed *dorotheae* from the northern shores of the Gulf of Mexico.

The present studies indicate that *Donax parvula* normally shows a two year life-span. Two age groups of *parvula* mixed with two age groups of *protracta* have completely blanketed growth studies on *Donax* in the Carolina region, and produced some false results in some previously published reports. Another reason for confusion of previous growth studies is some evidence at hand that *parvula* may spawn and set its young later in the season than does *protracta*. In November 1958, two sizes were evident in the *parvula* population sampled at Windy Hill Beach, South Carolina. One group was adult, ranging from 10 to 15 mm in length. The younger group (probably spawned in 1958) were minute, ranging from 3 to 5 mm in length.

***Donax dorotheae* new species**

Pl. 1, fig. Do

1889. *Donax obesa* Dall (in part), Bull. 37 USNM, p. 58 (not *obesa* Orbigny 1846).
 1903. *Donax obesa* Dall (in part), Bull. 37 USNM. Reprint, p. 58.
 1904. *Donax obesa* Vanatta, Proc. ANSP, 55: 757.
 1920. *Donax tumida* Maury (in part), Bull. Amer. Paleont., 8: 128, (not *tumida* Phil. 1849).
 1920. *Donax obesa* Maury, Bull. Amer. Paleont., 8: 129.
 1929. *Donax tumida* Johnson (in part), Nautilus, 43 (1): 30.
 1929. *Donax tumida* Clench, Nautilus, 43 (1): 35.
 1934. *Donax tumidus* Johnson, Proc. Boston Soc. Nat. Hist., 40 (1): 54.
 1942. *Donax variabilis* Harry, Occ. Papers, Marine Lab., L.S.U., No. 1. (Not *variabilis* Say 1822).
 1952. *Donax tumida* Pulley (in part), Texas Journ. Sci., 1952 (2): 183.
 1956. *Donax tumida* Parker, Bull. Am. Assn. Petroleum Geol., 40 (2): 295-376 Plate 6, figs. 6a, 6b.
 1957. *Donax tumida* Loesch (in part), Publ., Inst. Marine Sci., Univ. Texas, 4 (2): 213-214.
 1961. *Donax tumida* Moore, Gulf Research Reports, 1 (1): 46.

Type locality: Alligator Point, Franklin Co., Florida.

Shell small to medium, oval, posteriorly ventricose, surface almost evenly smooth from anterior to posterior margins. Posterior slope roundly biangulate, with the posterior point at almost mid height. The left valve is higher, distinctly overlapping the right valve ventrally behind the middle. The ventral margin is regularly rounded, almost continuous with the upswept basal curve. Pallial sinus relatively large, more than half the height of the general mantle chamber, and more than half the length between the adductor muscle scars. The ventral internal margins of the valves are regularly denticulate, as in all other Western Atlantic species of the genus *Donax*.

The holotype, U.S.N.M. No. 679773, was collected at Alligator Point, Franklin Co., Florida, February 1968 by William J. Tiffany III in the course of his research on *Donax*. It measures 14.0 mm \times 8.5 mm \times 6.9 mm. Paratypes, U.S.N.M. No. 680614, from the same original lot, measure: 16.0 mm \times 9.4 mm \times 7.6 mm, 15.5 mm \times 9.4 mm \times 7.2 mm, 14.9 mm \times 9.1 mm \times 7.4 mm, 14.0 mm \times 8.6 mm \times 6.6 mm, 13.0 mm \times 7.8 mm \times 6.3 mm, 10.6 mm \times 6.7 mm \times 5.5 mm and 10.0 mm \times 6.4 mm \times 5.0 mm.

Additional paratypes from the same original lot, ANSP No. 316126; from Indian Pass, Apalachicola Bay, Fla., ANSP No. 83833; Crooked Island, off St. Andrews Sound, Fla., ANSP No. 83832; St. Joseph Bay, Fla., ANSP No. 83831; Pensacola, Fla., USNM Nos. 103200, 706469, and 706471; Horn Island, Miss., ANSP No. 81066; near Ships Island, Miss., Gulf Coast Res. Lab. Colln.; Grand Isle, La., USNM Nos. 680746, 680750, 706475, and 706477; Grande Terre, La., USNM No. 680615; Isles Derniere, La., (90°45' W. Long.), USNM No. 680616, and the Houston Mus. Nat. Sci. Colln.; Cameron Parish, La., USNM Nos. 467020, 681612, 681615, 681617, 706472, and 706473; and Jefferson County, Texas, USNM Nos. 681619 and 681623, have been studied to date.

Commonly reported previously as *tumidus*, *dorotheae* also shows the ventral overlap of the left valve below the right, as in *texasiana*. In contrast to the beaded or crenulate posterior dorsal slope of *texasiana*, *dorotheae* is smooth, barely radially striate there.

This species parallels, in its subtidal or extremely low tidal zonation, the Atlantic coastal *Donax parvula*, and the even more closely related *D. texasiana* Philippi, as reported by Loesch 1957. Harry (1942) recorded it as living in 1 to 6 ft. of water in front of the beach at Grande Isle, Louisiana. It has also been dredged in 4 ft. of water off Dog Keys, off the eastern end of Ships Island, and in 13 feet of water in Mississippi Sound, halfway out to Ships Island, Mississippi.

On 3 January 1970, a population concentration of more than 10,000 immature individuals per linear foot of beach was found near the low tide line on Grand Isle, Louisiana. Living in the same sand with them was

an extremely sparse population of approximately two individuals of *Donax roemeri protracta* per linear foot of beach.

This species is named in appreciation of (Mrs.) Dorothy Morrison, who has been forbearingly tolerant of time-consuming malacological research for four decades.

Donax texasiana Philippi 1847

Pl. 1, fig. T; and Pl. 2, fig. T

1847. *Donax texasiana* Philippi, Zeits. f. Malakoz., 4: 77.
 1849. *Donax tumida* Philippi, Zeits. f. Malakoz., 5: 147.
 1849. *Donax texasiana* Philippi, Roemer's Texas, p. 452.
 1849. *Donax tumida* Philippi, Roemer's Texas, p. 453.
 1869. *Donax texasianus* Tryon, Am. J. Conch., 4 (5): append., p. 114.
 1869. *Donax tumidus* Tryon, Am. J. Conch., 4 (5): append., p. 114.
 1869. *Donax* (*Serrula*) *texasiana* Romer, Conch. Cab., 10 (3): 40: pl. 8: figs. 1-4.
 1881. *Donax texasianus* Bertin, Nouv. Archiv. Mus. (ser. 2), 4: 105.
 1881. *Donax tumidus* Bertin, Nouv. Archiv. Mus. (ser. 2), 4: 106.
 1889. *Donax obesa* Dall (in part), Bull. 37 USNM, p. 58.
 1891. *Donax fossor* Baker, Proc. ANSP., p. 48 (Veracruz).
 1892. *Donax texasiana* Dall, Nautilus, 5 (11): 126.
 1892. *Donax tumida* Dall (in part), Nautilus, 5 (11): 126.
 1893. *Donax tumida* Singley, 4th Ann. Rept. Geol. Survey Texas, p. 328.
 1895. *Donax tumida* Harris, Bull. Amer. Paleont., 1: 92.
 1903. *Donax obesa* Dall (in part), Bull. 37 USNM. Reprint, p. 58.
 1920. *Donax texasiana* Maury, Bull. Amer. Paleont., 8: 128.
 1920. *Donax tumida* Maury (in part), Bull. Amer. Paleont., 8: 128.
 1929. *Donax tumida* Johnson (in part), Nautilus, 43 (1): 30.
 1934. *Donax texasiana* Johnson, Proc. Boston Soc. Nat. Hist., 40 (1): 54.
 1934. *Donax tumidus* Johnson (in part), Proc. Boston Soc. Nat. Hist., 40 (1): 54.
 1937. *Donax tumida* M. Smith (in part), E. Coast Marine Shells, p. 62: pl. 10: fig. 9.
 1952. *Donax tumida* Pulley (in part), Texas Journ. Sci., 1952 (2): 183.
 1957. *Donax tumida* Loesch (in part), Publ. Inst. Marine Sci., Univ. Texas, 4 (2): 205.
 1968. *Donax tumidus* Abbott, Sea Shells N. America, p. 248, fig'd.

Type localities: *texasiana* Galveston, Texas (Philippi 1847); *tumida* Galveston, Texas (Philippi 1849).

Actually *texasiana* was the name given two year old specimens 12 mm long, while two years later *tumida* was based on (one year old?) shells 9 mm long. This smaller species is much more rotund, more rounded posteriorly, without the prominent posterior ridge of *roemeri* shells which may be found on the same beaches between the Mississippi delta and Vera Cruz, Mexico. *D. texasiana* is minutely beaded or crenulate

on the posterior slope; *roemeri* is radiately striate only, but distinctly so, on this part of the shell; *dorotheae* living east of the range of *texasiana* is smooth on the rounded posterior slope.

This species is now recorded from Cameron Parish, Louisiana, and Galveston, Texas (the type locality) southward to Vera Cruz, Mexico. It has not been critically searched for south of the City of Vera Cruz, so its range along the southern Gulf of Mexico shores is unknown.

In 1957 Loesch pointed out the ventral overlap of the left valve, which will differentiate *texasiana* from *roemeri*, with which it may be living on occasion. Loesch also reported that this species lives part of the year below the low tide line. His explanations and collections are not complete, however; "After a storm" numerous 6 mm long individuals of *texasiana* showed up as 30 percent or more of the samples, in contrast to a previous 100 percent of *roemeri*. This can only be explained as a storm shift of the immature *texasiana* into the intertidal surf zone, from the subtidal waters. Certainly no species of *Donax* "sets" out of the larval stage at a length of 6 mm. Loesch also said that *texasiana* and *roemeri* lived together in the spring months in the surf, but had no records or proof of observations to support this statement. In all of Loesch's published report, there is no record of collections or of observations of any species of *Donax* whatsoever either on the Texas or Louisiana coasts, in the "spring months" between December and May! On the other hand, the subtidal habitat of *texasiana* was at least partially conformed by the fact that none were present in the intertidal sands of Mustang Island when *roemeri* was there in July 1968.

Donax roemeri roemeri Philippi 1849

Pl. 1, fig. RR

1849. *Donax roemeri* Philippi, Zeits. f. Malakoz., 5: 147.
 1849. *Donax roemeri* Philippi, Roemer's Texas, p. 452.
 1869. *Donax roemeri* Tryon, Am. J. Conch., 4 (5): append., p. 113.
 1881. *Donax roemeri* Bertin, Nouv. Arch. Mus. (ser. 2), 4: 104.
 1881. *Donax variabilis* Bertin (in part), Nouv. Arch. Mus. (ser. 2), 4: 91.
 1891. *Donax variabilis* Baker, Proc. ANSP., P. 48.
 1892. *Donax roemeri* Dall, Nautilus, 5 (11): 125.
 1893. *Donax roemeri* Singley, 4th Ann. Rept. Geol. Survey Texas, p. 328.
 1920. *Donax roemeri* Maury, Bull. Amer. Paleont., 8: 129.
 1926. *Donax variabilis* Weisbord (not of Say), Nautilus, 39: 84.
 1934. *Donax roemeri* Johnson, Proc. Boston Soc. Nat. Hist., 40 (1): 54.
 1942. *Donax denticulata* Harry (not of Linn.), Occ. Papers Marine Lab., L.S.U. No. 1.
 1949. *Donax variabilis* Pulley, Texas Journ. Sci., 1 (3): 66.
 1952. *Donax texasiana* Pulley (not *texasiana* Phil. 1847), Texas Journ. Sci., 1952 (2): 183: pl. 12: figs. 10-11.
 1952. *Donax roemeri* Pulley, Texas Journ. Sci., 1952 (2): 183.

1952. *Donax variabilis* Pulley, Texas Journ. Sci., 1952 (2): 183.
 1957. *Donax variabilis texasiana* Loesch (not *texasiana* Phil.), Publ. Inst. Marine Sci., Univ. of Texas, 4 (2): 201-227.
 1968. *Donax variabilis roemeri* Abbott, Sea Shells N. America, p. 248.

Type locality: Galveston, Texas (Philippi 1849).

The typical form of *D. roemeri roemeri* from Galveston is almost as variable as, and overlaps forms of what is considered *protracta* from the Atlantic coast beaches of the United States. It is recorded from Louisiana, west of the Mississippi delta, south along the Texas and the Mexican beaches, and eastward along the Gulf of Mexico shores at least as far as Chenkan, Campeche. Beyond the shores of the Yucatan peninsula it seems to be replaced by two other species.

All the specimens seen to date indicate that *Donax roemeri roemeri* has a normal life span of two years, just the same as in the case of the eastern subspecies *Donax roemeri protracta*. As far as known to date, *Donax roemeri* lives only intertidally (all year round). Because they are in the intertidal sands whenever they are present on any particular stretch of beach, they are the most obvious, and the most often collected *Donax* of their region.

Donax denticulata Linnaeus 1758

Pl. 1, fig. De; and Pl. 2, fig. De

1685. ——— Lister, 2: 8: 1: 376: 218, (Nevis).
 1757. Le Nussar ——— Adanson, Senegal, p. 238, pl. 18, fig. 3.
 1758. *Donax denticulata* Linnaeus, Syst. Nat., 10th Edn., p. 683.
 1770. *Donax denticulata* Linnaeus, Syst. Nat., 12th Edn., p. 1127.
 1770. *Donax denticulata* Linnaeus, Syst. Nat., 12th Edn., p. 1127.
 1770. ——— Lister (Huddesford Edn.), 376: 218.
 1777. *Chion denticulatus* Scopoli, Introd. Hist. Nat., p. 398.
 1778. *Cuneus truncatus* DaCosta, Brit. Conch., p. 205, sp. 40.
 1782. ——— Chemnitz, Conch. Cab., 6: 262: pl. 26: figs. 256-7.
 1791. *Donax denticulata* Gmelin, Syst. Nat., 13th Edn., p. 3263 ("Medit. Atlantic American").
 1797. ——— Bruguiere, Encyclop. Method., Pl. 262, fig. 7.
 1800. *Donax crenulata* Donovan, British Shells, vol. 1, pl. 24.
 1817. *Donax denticulata* Dillwyn, Descr. Cat. 1: 151.
 1818. *Donax caianensis* Lamarck, Anim. Sans Vert., 5: 550, No. 18.
 1818. *Donax denticulata* Lamarck, Anim. Sans Vert., 5: 550, No. 20.
 1825. *Donax denticulata* Wood, Index. Test., p. 32, pl. 6, fig. 8.
 1828. *Donax sexradiata* Gray, Wood Index. Test., suppl., 5: pl. 2, fig. 5.
 1841. *Donax caianensis* Delessert, Coq. de Lam., Pl. 6, fig. 13.
 1843. *Donax cayennensis* Hanley, Bivalve Shells, p. 82.
 1843. *Donax denticulata* Hanley, Bivalve Shells, p. 82.
 1844. *Donax cayennensis* Hanley, Bivalve Shells, p. 349, pl. 13, fig. 8.
 1846. *Donax cayannensis* Orbigny, Voyage Amer. Merid., p. 540, No. 544.
 1846. *Donax cayannensis* Orbigny, Sagra's Cuba (Sp. Edn.), p. 308.

1847. *Donax cayanensis* Orbigny, Sagra's Cuba (Fr. Edn.), 2: 260.
1854. *Donax denticulata* Reeve, Conch. Icon., 8 *Donax*, pl. 7, sp. 48.
1855. *Donax denticulata* Hanley, Linnaean Shells, p. 61.
1858. *Donax denticulata* Beau, Cat. Coquilles Guadeloupe, etc., p. 25.
1864. *Donax cayennensis* Krebs, W. Indian Marine Shells, p. 99.
1864. *Donax denticulatus* Krebs, W. Indian Marine Shells, p. 99.
1866. *Donax denticulata* Sowerby, Thesaurus, 3: 308: sp. 24: figs. 33-36.
1869. *Donax cayenensis* Tryon, Am. J. Conch., 4 (5): append., p. 107.
1869. *Donax denticulatus* Tryon, Am. J. Conch., 4 (5): append., p. 108.
1869. *Donax (Chion) denticulatus* Romer, Conch. Cab., 10 (3): 21: pl. 2, figs. 4-5, and pl. 5, figs. 1-7.
1870. *Donax denticulatus* Humbert (French Edn.), Woodward's Conchyl., p. 499, pl. 21, fig. 19.
1871. *Donax denticulatus* Tate, Woodward's Manual (Edn. 2), p. 540: pl. 21, fig. 19.
1877. *Donax denticulatus* Guppy, Proc. Sci. Assn. Trinidad, 2 (2): 148.
1878. *Donax cayenensis* Arango, Contr. Fauna Mal. Cubana, p. 247.
1878. *Donax denticulatus* Arango, Contr. Fauna Mal. Cubana, p. 247.
1881. *Donax (Chion) denticulatus* Bertin, Nouv. Arch. Mus. N. H. (2), 4: 81.
1884. *Donax denticulatus* Tryon, Struct. & Syst. Conch., 3: 172: pl. 112: figs. 80-81.
1886. *Donax denticulatus* Fischer, Manuel de Conch., p. 1102, pl. 21, fig. 19.
1887. *Donax denticulatus* Schepman, Samml. Geol. Reichs Museums Leiden, Ser. 2, bd. 1, p. 158.
1889. *Donax denticulatus* Dall, Bull. 37, USNM, p. 58.
1889. *Donax denticulatus* Simpson, Proc. Davenport Acad. Sci., 5: 63.
1891. *Donax denticulatus* Baker, Proc. ANSP, 43: 48.
1892. *Donax denticulata* Dall, Nautilus, 5 (11): 125.
1894. *Donax denticulatus* Guppy, Proc. Victoria Inst. of Trinidad, part 2, p. 141.
1900. *Donax denticulata* Dall, Tert. Fauna Fla., 3 (5): 963, 965.
1901. *Donax denticulata* Dall & Simpson, Bull. U.S.F.C., 20 (1) 1900: 476.
1903. *Donax denticulata* Dall, Bull. 37, USNM. Reprint, p. 58.
1914. *Donax denticulata* Lamy, Bull. Mus. Nat. Hist., Paris 20 (6): 340.
1920. *Donax denticulata* Maury, Bull. Amer. Paleont., 8: 128.
1934. *Donax denticulata* Johnson, Proc. Boston Soc. Nat. Hist., 40 (1): 54.
1936. *Donax denticulata* McLean, Mem. Soc. Cubana. H. N. "Poey", 10 (1): 42.
1937. *Donax denticulatus* M. Smith, East Coast Marine Shells, p. 62: pl. 25: fig. 3.

1940. *Donax denticulatus* M. Smith, World Wide Sea Shells, p. 113, fig. 1481.
1940. *Donax denticulata* Richards, Soc. Venez. Cienc. Nat., Bol. 6 (46): 306.
1943. *Donax denticulata* Richards, Journ. Paleont., 17 (1): 121.
1945. *Donax denticulatus* Jutting, Geol. Mijnbowk, Gen. Ned. en Kolonien, Geol. Ser., Vol. 14, p. 78.
1947. *Donax denticulatus* Morris, Field Guide Shells, p. 58, 98: pl. 21: fig. 8.
1948. *Donax cayennensis*, Clench, Aguayo & Turner (Republication of Krebs 1864), Rev. de la So. Malac. "Carlos de la Torre," p. 17.
1949. *Donax denticulatus* Morretes, Arq. Mus. Paranense, 7 (1): 41.
1951. *Donax denticulatus* Morris, Field Guide Shells, 2nd Edn., p. 82, p. 108: pl. 21: fig. 8.
1951. *Donax denticulata* McLean, N. Y. Acad. Sci., Sci. Survey P. Rico & the Virgin Ids., 17 (1): 105: pl. 21: fig. 7.
1952. *Donax denticulatus* Dodge, Bull. Am. Mus. N. H., 100 (1): 83.
1954. *Donax denticulata* Abbott, American Sea Shells, p. 438, pl. 30p.
1958. *Donax denticulata* Olsson & McGinty, Bull. Amer. Paleont., 39 (177): 22.
1959. *Donax denticulata* Usticke, Checklist Marine Shells St. Croix, p. 19.
1961. *Donax denticulatus* Warmke & Abbott, Caribbean Sea Shells, p. 201, pl. 41: 42d.
1964. *Donax denticulatus* Weisbord, Bull. Amer. Paleont., 45 (204): p. 361: pl. 52: figs. 3-8.
1965. *Donax denticulata* Wade, Proc. Gulf & Carib. Fish. Inst., 17th Ann. Sess., (1964), pp. 36-42.
1967. *Donax denticulatus* MacSotay, Geominas, Bol. 5, p. 43.
1967. *Donax denticulatus* Wade, Bull. Marine Sci., 17 (1): 149-174.
1968. *Donax denticulatus* Wade, Bull. Marine Sci., 18 (4): 876-901.
1968. *Donax denticulatus* Altena, Fauna Suriname, etc., Vol. 10, no. 42, p. 177.
1969. *Donax denticulatus* Altena, Marine Moll. Suriname, pp. 18, 19.

Type localities: *denticulata* Mediterranean (Linn. 1758 in error): *truncatus* Shores of England, Wales, Scotland and Ireland (Dacosta 1778 in error): *crenulata* Western Coasts of England, Ireland and Scotland (Donovan 1800 in error): *caianensis* Ocean of Guyana (Lamarck 1818): *sexradiata* no locality (Gray 1828): *cayanensis* Bahia, Brasil & Sta Lucia (Orbigny 1846). In the absence of any previous declaration except that this species is West Indian, the type locality of *Donax denticulatus* is here restricted to the original locality published by Lister, namely: Nevis Island, B.W.I.

This could be the typical West Indian species of *Donax*. It is reported from Nassau in the Bahamas, and known to be living on the sandy shores of all the Greater Antilles, and the Lesser Antilles, all the way southward to the Islands of Tobago and Trinidad. On the Central

American beaches, it is living from the north coast of Honduras (Puerto Cortez) all the way south to Aspinwall (Colon) Panama, and eastward to Cartagena, Colombia; Puerto Cabello, Venezuela; to Curacao, to Suriname. It has been reported from northern Brazil at Salinopolis, Para: Fortaleza, Ceara; and Jaragua, Paripuera, Alagoas.

Donax denticulatus reached England early enough from the West Indies to have been figured in Dr. Lister's Picture Book of Shells (1685). It has received a few other names in addition to that given by Linnaeus in 1758, but it remains as the most beautifully sculptured of all the Western Atlantic species of *Donax*. The general surface of this shell, forward of the escutcheon, is radially sculptured with wide flat ribs, separated by punctulate grooves. These continue over the posterior ridge, but are replaced by wavy transverse sculpture on the central escutcheon area in striking contrast to the punctulate radial sculpture over the rest of the shell.

Barry Wade has recorded the ecology of this species on Jamaican shores. It apparently stays in the intertidal sands more continuously than do other species of the same region. Without a reduction in rate of growth in the winter season on these subtropical beaches, there is less of a distinct separation of year-classes in these *Donax* populations. On the other hand, Wade very plainly showed that any age group or "set" of young has an 18 month growth and life-span, to parallel the two growth seasons of our more northern (temperate and sub-temperate) species that are interrupted by a winter season of very slow growth. The details of seasonal occurrence and actual sizes on any of the tropical West Indian beaches may be variable, but I believe will agree with Wade's Jamaican studies on the life history and life-span of *Donax denticulatus*.

Donax striata Linnaeus 1767

Pl. 1, fig. 5

1685. ——— Lister, 2: 8: 1: 376: 219 (Jamaica).
 1767. *Donax striata* Linnaeus, Syst. Nat., 12th Edn., p. 1127.
 1770. ——— Knorr, Deliciae, 6: 7: 7.
 1770. ——— Lister, Huddesford Edn., 376: 219.
 1791. *Donax striata* Gmelin, Syst. Nat. 13th Edn., p. 3263.
 1797. ——— Bruguiere, Encycloped. Method., pl. 262, fig. 5.
 1817. *Donax striata* Dillwyn Descr. Cat., 1: 151.
 1825. *Donax striata* Wood, Index test., p. 31, pl. 6, fig. 7.
 1843. *Donax striata* Hanley, Bivalve Shells, p. 82.
 1844. *Donax striatus* Hanley, Bivalve Shells, p. 349, pl. 14, fig. 32.
 1846. *Donax rugosa* Orbigny, Sagra's Cuba, p. 309 (Sp. Edn.) (Not: *D. rugosa* Linn. 1758).
 1847. *Donax rugosa* Orbigny, Sagra's Cuba, 2: 260 (Fr. Edn.).
 1853. *Donax flexuosa* Gould, Boston Journ. Nat. Hist., 6: 394: pl. 15: fig. 8. (Not of Cooper, 1888; from wrong locality).
 1854. *Donax lamarckii* Reeve, Conch. Icon., 8 *Donax*, pl. 5, sp. 27.

1855. *Donax striata* Hanley, Linnaean Shells, p. 61.
1855. *Donax striata* Hanley, Index. Test., Hanley's Edn., p. 82, pl. 14, fig. 32.
1864. *Donax rugosa* Krebs, W. Indian Marine Shells, p. 99 (Not of Linn.).
1864. *Donax striata* Guppy, Trans. Sci. Assoc. Trinidad, pp. 164, 167.
1866. *Donax striata* Sowerby, Thesaurus, 3: 309; sp. 25; fig. 52.
1867. *Donax striata* Tryon, Amer. J. Conch., 4 (5): append., No. 15, p. 113.
1869. *Donax striatus* Romer, Conch. Cab., 10 (3): 12; pl. 5; figs. 8-10.
1869. *Donax (Serrula) flexuosus* Romer, Conch. Cab., 10 (3): 61; pl. 11; figs. 1-4.
1877. *Donax striatus* Guppy, Proc. Sci. Assn. Trinidad, 2 (2): 148.
1878. *Donax rugosa* Arango, Contr. Fauna Mal. Cubana, p. 247.
1881. *Donax striatus* Bertin, Nouv. Arch. Mus. (ser. 2), 4: 94.
1881. *Donax flexuosus* Bertin, Nouv. Arch. Mus. (ser. 2), 4: 102.
1887. *Donax striatus* Schepman, Samml. Reichs Museums Leiden, Ser. 2, bd. 1, p. 158.
1892. *Donax striata* Dall, Nautilus, 5 (11): 125.
1894. *Donax striatus* Guppy, Proc. Victoria Instit. Trinidad, Part 2, p. 141.
1900. *Donax striata* Dall, Tert. Fauna Fla., 3 (5): 968.
1911. *Donax denticulata* Da Rocha (not *denticulatus* L.), Bol. do Mus. Rocha, 1 (2): 31.
1914. *Donax striata* Lamy, Bull. Mus. H. N. Paris, 20 (6): 338.
1915. *Donax cacuminatus* Sowerby, Ann. Mag. Nat. Hist. (ser. 8), vol. 16 (no. 93): p. 170; pl. 10; fig. 13.
1920. *Donax mediamericana* Pilsbry, Proc. ANSP, 1919: 222; pl. 11; fig. 10.
1920. *Donax mediamericana* Pilsbry, Proc. ANSP, 1920: 195.
1924. *Donax striata* Strong, Nautilus, 37 (3): 83.
1925. *Donax striata* Maury, Bull. Amer. Paleont., 10 (42): 268.
1934. *Donax striata* Maury, Bull. Am. Mus. Nat. Hist., 67 (4): 165-6; pl. 19; fig. 5.
1945. *Donax striatus* Jutting, Geol. Mijnbowk, Gen. Ned. en Kolon., Geol. Ser., vol. 1, p. 78.
1948. *Donax rugosa* Clench, Aguayo & Turner, (Republication of Krebs 1864) Rev. de la Soc. Malac. "Carlos de la Torre," p. 17.
1951. *Donax fossor* Morris (in part), Field Guide Shells, 2nd Edn., pl. 43, fig. 10.
1952. *Donax striatus* Dodge, Bull. Am. Mus. Nat. Hist., 100 (1): 81-82.
1954. *Donax striata* Abbott, American Seashells, p. 438.
1958. *Donax striatus* Olsson & McGinty, Bull. Amer. Paleont., 39 (177): 22.
1961. *Donax striatus* Warmke & Abbott, Caribbean Seashells, p. 202, pl. 42h.

1961. *Donax striatus* Olsson, Panamic-Pacific Pelecypods, pp. 340, 343.
 1964. *Donax striatus* Weisbord, Bull. Amer. Paleont., 45 (204): p. 363: pl. 52: figs. 9-17.
 1967. *Donax striatus* MacSotay, Geominas, Vol. 5, p. 43.
 1967. *Donax striatus* Wade, Bull. Marine Sci., 17 (1): 162 and 168.
 1968. *Donax striatus* Altena Fauna Suriname, etc., Vol. 10, No. 42, p. 177.
 1969. *Donax striatus* Altena, Marine Moll. Suriname, pp. 18, 19.

Type localities: *striatus* (Ocean of Southern Europe, in error (Linn. 1767)). *flexuosa* Gould, Santa Barbara, Calif. (Gould 1853 in error). *lamarckii* (of no locality) Reeve 1854. *cacuminatus* New Caledonia (Sowerby 1915 in error). *mediamericana* Livingston, Guatemala (Pilsbry 1920). The type locality of *Donax striata* is here restricted to shores of Jamaica, the first locality recorded by Lister 1685.

This largest Atlantic species of Central America is higher, more strongly triangular, with a much sharper posterior ridge than either *denticulata* or *vellicata* with which it may be living. The sculpture of *striata* on the posterior slope consists only of regular radial ridges. It has none of the punctulate incised lines of *denticulata*.

Donax striata is recorded only from Jamaica, Hispaniola and Puerto Rico, of the Greater Antilles. On continental shores, it is living from 17° 14' North latitude near Belize, British Honduras, south to Colon, Panama, and eastward on Colombian and Venezuelan beaches to Trinidad and Suriname, and also northern Brazil. In Brazil it has been collected on the shores of Maranhao, Piaui, Ceara and Rio Grande do Norte.

The geographic ranges of *Donax striata* and *D. denticulata* overlap to a great extent. Wade (in 1967) has shown that though they may be living together in the same sand beach, their tidal reactions and migrations may be different. In one set of studies on Jamaican shores, Wade found that both species were together in the wash or intertidal surf zone when the tide was high. When the tide receded *denticulata* moved downward with the tidal level, while *striata* remained in the higher intertidal sands. In other words, *Donax striata* lives in the sand at a certain level or zone of the intertidal slope. If it lives there at all times, whether the water is high or low, it as a species parallels the habit of *Donax roemeri* on the shores of the southern United States of (North) America.

Donax vellicata Reeve 1855

Pl. 1, Fig. V; and Pl. 2, Fig. V

1855. *Donax vellicata* Reeve, Conch. Icon., 8 *Donax*, pl. 9, sp. 66.
 1864. *Donax* ——— Krebs, W. Indian Marine Shells, p. 99 (Cumana, Chagres & St. Juan del Norte).
 1866. *Donax vellicatus* Sowerby, Thesaurus, 3: 313: sp. 53, figs. 61-63.
 1869. *Donax (Serrula) vellicatus* Tryon, Am. Journ. Conch., 4 (5): append. p. 114.

1869. *Donax (Serrula) vellicatus* Romer, Conch. Cab., 10 (3): 37: pl. 7: figs. 10-13.
1877. *Donax pulchellus* Guppy, Proc. Sci. Assn. Trinidad, 2 (2): 148. (Not *D. pulchellus* Hanley 1843).
1881. *Donax vellicatus* Bertin, Nouv. Arch. Mus. (ser. 2), 4: 106.
1894. *Donax pulchellus* Guppy, Proc. Victoria Inst. Trinidad, p. 141 (Not *D. pulchellus* Hanley 1843).
1948. *Donax* ——— Clench, Aguayo, & Turner (Republication of Krebs 1864), Rev. de la Soc. Malac. "Carlos de la Torre," p. 17. (Cumana, Chagres & St. Juan del Norte).
1964. *Donax higuerotensis* Weisbord, Bull. Amer. Paleont., 45 (204): p. 366: pl. 53: figs. 1-9.
1967. *Donax higuerotensis* MacSotay, Geominas, Bol. 5, p. 43.
1969. *Donax striata* var. *intermedius* Usticke, Suppl. List St. Croix Shells, p. 7, pl. 1. (Trinidad).

Type localities: *vellicata* (locality unknown) (Reeve, 1855). *higuerotensis* beach at Higuerote, Venezuela (Weisbord, 1964). *Intermedius* Trinidad (Usticke, 1969).

Photographs of the holotype of *vellicata* Reeve, kindly furnished by Dr. John F. Peake of the British Museum (Natural History), correspond in characters with the specimens here figured. The holotype of *vellicata* may have been collected on some northern Brazilian shore. Because it has almost the exact appearance of some now catalogued as A.N.S.P. no. 300325 (from that locality), the type locality of *Donax vellicata* Reeve is here restricted to the Praia Upanema, Arica Branca, Rio Grande do Norte, Brazil.

Donax vellicata is known to be living on Western Atlantic shores between Belize, Panama, Trinidad, and northern Brazil. Apparently it has been less often seen and collected than either *denticulata* or *striata*, either or both of which may be living in the same sandy beach. Krebs, in 1864, reported this species as the third species he had seen from Central American shores, but did not put a name on it. Guppy recorded it from Trinidad in 1877 (as *pulchellus*). Recently it has been noticed (and named) by Weisbord 1964; MacSotay, 1967; and Usticke, 1969 (as *higuerotensis*, and *intermedius*). It has been identified as *Donax variabilis* by some authors because of its similarity of shape, but internally the shells are different. *D. vellicata* has a much smaller pallial sinus than other American species of comparable size. In *vellicata*, the pallial sinus is markedly less than half the length of the span between the anterior and posterior adductor muscle scars.

In the case of *vellicata*, the denticulations on the edge of the shell are more nearly equal in number and width immediately in front of and behind the posterior ridge. In *striata*, the denticulations immediately in front of the more sharply angled posterior ridge appear to be twice as wide (half as numerous) as along the posterior edge of the shell. This change in size of denticulations is very abrupt in most *striata* shells seen.

MacSotay 1967, in studying the zonation of species in the biotop of *Donax* on Venezuelan shores, indicated that *vellicata* might be more abundant in the immediate subtidal zone. The type locality sample from the Praia Upanema, Arica Branca, Rio Grande do Norte (ANSP no. 300325) consisted of hundreds of this species, and only scores of *D. striata*, apparently living together. Young specimens, probably of *vellicata*, have been seen from Ponta Verde, Maceio, Alagoas, Brasil (ANSP no. 244133).

***Donax gemmula* new species**

Pl. 2, fig. G

1897. *Donax obesa* Ihering, Revista do Museu Paulista, 2: 168. (not *D. obesa* Orbigny 1846).
1949. *Donax tumida* Morretes, Arquiv. do Museu Paranaense, 7 (1): 42, (not *D. tumida* Philippi 1849).

Type locality: Praia do Cassino, Rio Grande, Rio Grande do Sul, Brazil.

Shell minute (for the genus), subglobose, triangular ovate in lateral outline, whitish, glossy, with pale triradial zones of purplish color, most evident on the interior of the shells. Umbones prominent, moderately rounded; anterior and posterior slopes nearly rectilinear; umbonal angle about 90°. The lateral shell surface is marked by spaced radial incised lines. The anterior margin is narrowly rounded, the ventral margin evenly full. The posterior slope is almost as glassy smooth as the rest of the shell. The posterior ridge is abruptly but evenly rounded, ending on a narrow-evenly rounded post-basal curve. Hinge plate narrow, with anterior and posterior laterals close to the umbones. The denticulations of the shell margins, subequal along the entire ventral margin, are somewhat finer along the post-basal curve. Pallial sinus proportionately large, more than half the height of the shell chamber, and more than half the length of the span between the adductor muscle scars.

The holotype, ANSP no. 244125, was collected from the Praia do Cassino, Rio Grande, Rio Grande do Sul, Brazil, by E. C. Rios, 17 January 1960. It measures 6.5 × 4.8 × 3.5 mm. Additional specimens, paratypes, from the same lot, are catalogued as ANSP no. 319027. Beach worn shells of this species were collected by Von Ihering from Sao Sebastiao, Sao Paulo (USNM no. 150783) a number of years ago. The Sao Sebastiao paratypes are part of those recorded as *obesa* by Ihering in 1897 and as *tumida* by Morretes in 1949.

This extremely small, glossy shell has been collected only a few times. It undoubtedly has been thought to be the youngest size of *Donax hilairia*, if it has been seen in the same places. It is more than interesting to speculate upon the reason why this smallest Western Atlantic *Donax* species from Sao Paulo and Rio Grande do Sul beaches is living in the same region as the largest *Donax* of the Western Atlantic, namely *Donax hilairia* Guerin. *Donax gemmula* is proven to be specifically

distinct by the complete lack of a sharp posterior ridge, such as the smallest shells of *D. hilairea* exhibit. It will be interesting to determine if *D. gemmula* might live in a different zone of the intertidal (or subtidal) habitats than does the much more obvious *Donax hilairea*.

Donax hilairea Guerin 1832

Pl. 1, fig. H

1832. *Donax hilairea* Guerin, Icon. du Regne Anim., pl. 30, fig. 4.
 1843. *Donax rugosa* Hanley (in part), Bivalve Shells, p. 82, (not *D. rugosa* Linnaeus).
 1843. *Donax elongata* Hanley (in part), Bivalve Shells, p. 82, (not *D. elongatus* Lamarck 1819).
 1844. *Donax elongata* Hanley, Bivalve Shells, p. 349, pl. 13, fig. 47.
 1844. *Donax denticulata* Guerin, Icon. du Regne Anim., Expl. text, p. 47. (not *D. denticulata* Linn. 1758).
 1847. *Donax hanleyana* Philippi, Zeits. f. Malakoz., 4: 84.
 1854. *Donax hanleyana* Reeve, Conch. Icon., 8 *Donax* pl. 2, sp. 6.
 1866. *Donax elongatus* Sowerby, Thesaurus 3: 208, sp. 22, fig. 12 (not *D. elongatus* Lamarck 1819).
 1868. *Donax elongata* Guerin (not of Lamarck), Icon. du Regne Anim., reprint, plate 29, fig. 4.
 1869. *Donax elongatus* Tryon (in part), Am. J. Conch., 4 (5): append., p. 108.
 1869. *Donax rugosus* Tryon (not of L.), Am. J. Conch., 4 (5): append., p. 109.
 1869. *Donax (Chion) hanleyanus* Romer, Conch. Cab., 10 (3): 18: pl. 4: figs. 5-8.
 1881. *Donax hanleyanus* Bertin, Nouv. Arch. du Mus., (ser. 2), 4. 84.
 1892. *Donax rugosa* Dall (in part), Nautilus, 5 (11): 125.
 1897. *Donax rugosa* Ihering, Revista do Museu Paulista, 2: 161.
 1949. *Donax hanleyana* Morretes, Arquiv. Mus. Paranense, 7 (1): 41.
 1950. *Donax hanleyana* Gofferje, Arquiv. Mus. Paranense, 8: 272.
 1950. *Donax hanleyana* Oliviera, Mem. do Institut. Oswaldo Cruz, 48: 373.
 1964. *Donax hanleyana* Magnanina & Filo, "Animas da Praia," Dept. Rec. Nat., Secr. de Econ., Est. de Guanabara, R 10., p. 16 (figured also in color on covers).

Type locality: both *hilairea* Guerin 1832, and *hanleyana* Philippi 1847, were published without a known locality. We are accepting the first locality published by Reeve (1854) as a designation and/or restriction of the type locality to Rio de Janeiro, Brazil.

The large *Donax hilairea* Guerin is apparently the most common, and certainly the most obvious *Donax* on southern Brazilian shores. It was recorded as one of the edible species by Von Ihering at Sao Sebastiao in

1897, under the name of "Beguaba." The common name of "Sernambi" is reported by Magnanina & Filo (1964, p. 16).

Specimens of *Donax hilairea* have been seen from Vitoria, Espiritu Santo, Brazil, as far south as the Isla de Lobos, off Punta del Este, Uruguay. It seems probable that the lack of records of *hilairea* from beaches north of Vitoria is due to lack of scientific collections from those Brazilian shores.

The strong radial ribs of the outer portion of the posterior slope are replaced on the distinct escutcheon by finer ribs and a tendency to transverse beaded sculpture, reminiscent of the closely related but distinct West African species, *Donax rugosa* Linnaeus. Even the youngest shells of *hilairea* seen have a very distinct ridge setting off the striated posterior slope, in contrast to the rounded posterior edge of *gemma* shells.

DOUBTFUL SPECIES RECORDS

It is doubtful that *Donax incerata* Reeve, 1855, is from the West Indies. Only two odd valves are known. It has not been rediscovered in more than a century.

Donax pulchella Hanley, 1843, supposedly from the West Indies, is as recorded by Nickles, 1950 a West African species.

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